

REMARKS

The Office Action dated May 12, 2009 has been received and carefully studied.

The Examiner requires restriction as between Group I, claims 2-10; Group II, claims 11-12; and Group III, claims 13-17. Applicants orally elected Group I, claims 2-10, with traverse.

The restriction requirement is respectfully traversed. The Examiner states that the common technical feature in all groups is the polyamide acid resin containing unsaturated group by reacting polyol, dianhydride and diamines, and that this element is not a special technical feature under PCT Rule 13.2 because the element is shown in the art in WO 2001/051991. However, as discussed in detail below, this element is not shown in WO 2001/051991. Accordingly, reconsideration and withdrawal of the restriction requirement is respectfully requested.

The Examiner objects to claim 2, and suggests that "polyamide resin (A)" be amended to "polyamide acid resin (A)". By the accompanying amendment, the Examiner's suggestion has been adopted.

The Examiner objects to claims 7-10 under 375 CFR §1.75(c) as being improper multiple dependent claims. By

the accompanying amendment, the improper dependencies of all claims have been eliminated.

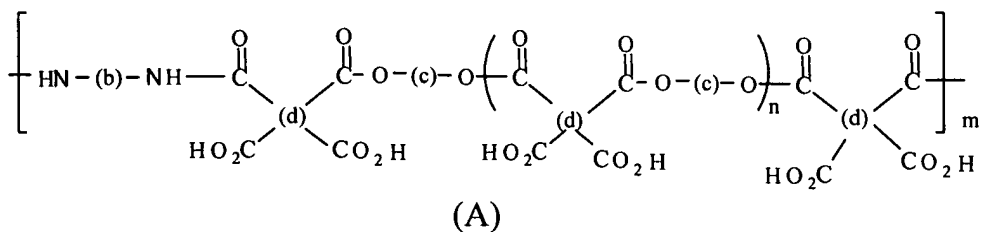
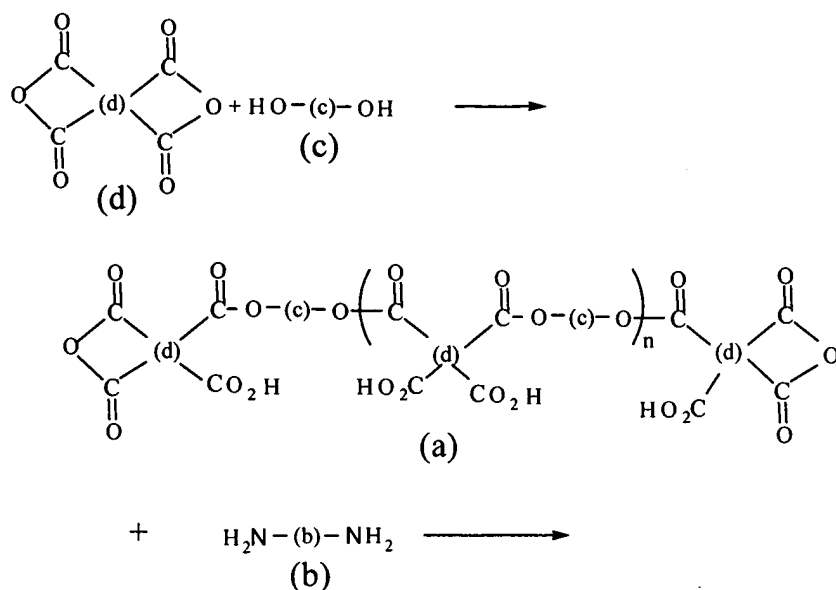
The Examiner rejects claims 2-8 under 35 U.S.C. §102(b) as being anticipated by Koyanagi et al., WO 0151991, using the machine translation of JP 2001192431, and claims 9-10 as anticipated by or, in the alternative, under 35 U.S.C. §103(a) as obvious over Koyanagi et al. The Examiner states that Koyanagi et al. disclose a polyamide acid in Examples 2 and 3 by reacting 3,4'-diaminophenyl ether, pyromellitic dianhydride and an unsaturated polyol, which is a reaction product of Bisphenol A/F and acrylic acid.

The rejection is respectfully traversed.

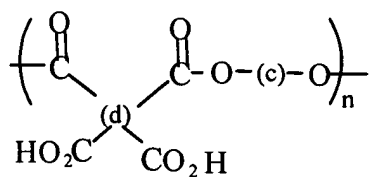
A partial translation of Koyanagi et al. is enclosed for the Examiner's convenience.

In the present instant claim 2, the reaction is as follows:

First, polyol compound (c) containing an unsaturated group is reacted with tetrabasic acid dianhydride (d) to obtain an unsaturated group-containing polyester resin (a) having a terminal anhydride group, and then the polyester resin (a) is reacted with a compound (b) having two amino groups to obtain a polyamide acid resin (A). The reaction can be represented by the following reaction scheme:



Accordingly, the present polyamide acid resin (A) has a structure wherein the polyester resin (a) having one or more the parenthetic ester units (polyester unit)



in the structure is further linked with a diamine represented by formula (b) by ring-opening addition polymerization.

Koyanagi et al. disclose following (1) to (5):

(1) An oligomer (A) is obtained by reacting an epoxy resin (a) containing two epoxy groups in one molecule with a compound (b) containing one unsaturated double bond and one carboxyl group in one molecule to give a polyunsaturated polyol compound (c), and further reacting the polyunsaturated polyol compound (c) with a diamine compound (d) and a compound (e) containing at least two acid anhydride groups in one molecule (see the abstract of JP2001-1092431).

(2) The methods of reacting the polyunsaturated polyol compound (c) with a diamine compound (d) and a compound (e) containing at least two acid anhydride groups in one molecule to obtain the oligomer (A) are:

(i) a method of reacting these compounds (polyol compound (c), a diamine compound (d) and a compound (e)) simultaneously, (the simultaneous method) and

(ii) a method first reacting the diamine compound (d) with the compound (e) to obtain polyamide prepolymer (f) and then reacting the polyamide prepolymer (f) with a polyol compound (c) (the two steps method) (0022).

(3) Polyamide prepolymer (f-1) was synthesized by reacting 3,4'-diaminophenylether with pyromellitic

dianhydride at 40°C for 5 hours (Synthesis Example 3) (0054).

(4) The oligomer (A-1) or (A-2) was synthesized by introducing (c-1) or (c-2) (polyol compound) obtained by Synthesis Examples 1 or 2, 3,4'-diaminophenylether and pyromellitic dianhydride, simultaneously, in a flask and reacting them at 40°C for 5 hours and at 98°C for 24 hours (Synthesis Example 4 and 5) (0055 and 0056).

(5) The oligomer (A-3) was synthesized by reacting the polyamide prepolymer (f-1) obtained by Synthesis Example 3 with (c-2) (polyol compound) obtained by Synthesis Example 2 at 98°C for 24 hours (0057).

Thus, Koyanagi et al. discloses two methods in paragraph [0022] for synthesizing oligomer (A), namely, (i) the simultaneous method, and (ii) the two steps method, as described above in item (2), and in Synthesis Examples 4 (0055) and 5 (0056), polyol compound (c), a diamine compound (d) and a dianhydride compound (e) were introduced in a flask simultaneously and the reaction was carried out at 40°C for 5 hours and further at 98°C for 24 hours. The reaction conditions of 40°C for 5 hours are the same as that in synthesis of polyamide prepolymer (f-1) by reaction (amidation) of 3,4'-diaminophenylether (d) with pyromellitic dianhydride (e) (Synthesis Example 3) (0054).

The reaction conditions of 98°C for 24 hours are the same as that in the synthesis of the oligomer (A-3) by reaction (esterification) of the polyamide prepolymer (f-1) with (c-2) (polyol compound).

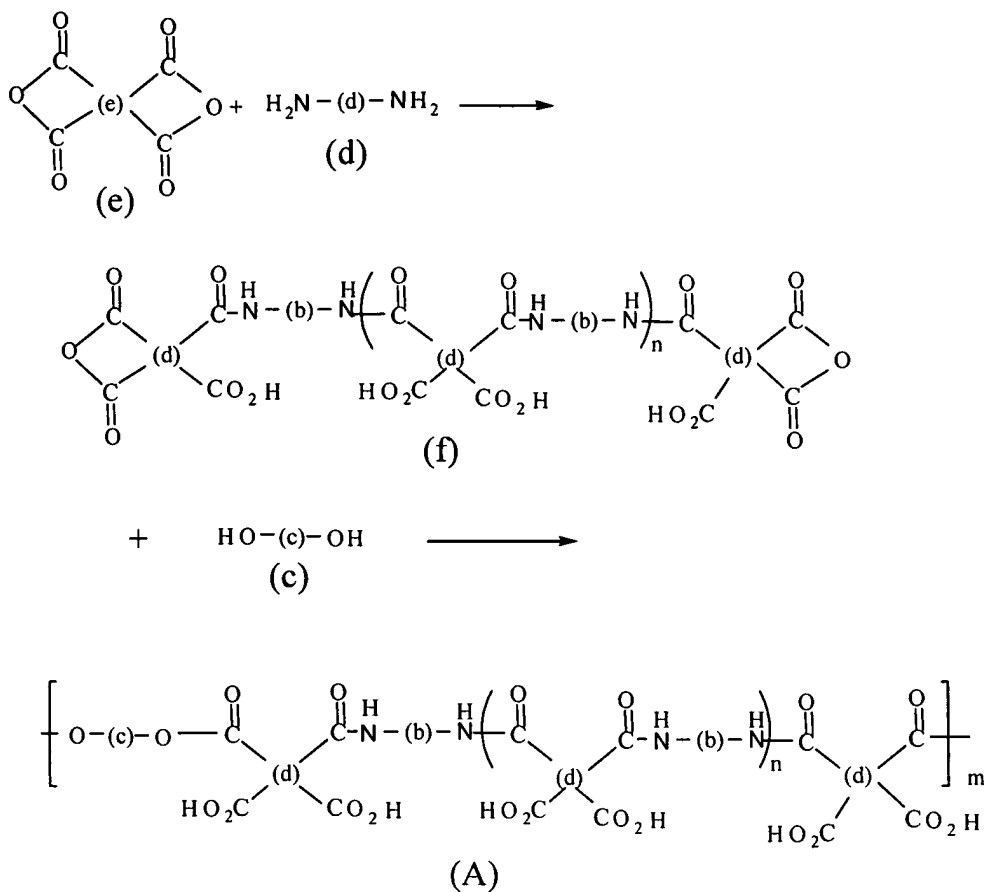
According to the above, although polyol compound (c), a diamine compound (d) and a dianhydride compound (e) were introduced in a flask simultaneously in Synthesis Examples 4 (0055) and 5 (0056), it is reasonable to consider that, first, the reaction of 3,4'-diaminophenylether (d) with pyromellitic dianhydride (e) is carried out to obtain a polyamide prepolymer (f) and then the reaction of the polyamide prepolymer (f) obtained by the first reaction with (c-2) (polyol compound) is carried out to obtain Koyanagi's oligomer (A).

Furthermore, the reaction conditions in the synthesis of the present polyester resin (a) obtained by reaction (esterification) of a polyol compound (c) with tetrabasic acid dianhydride (d) are 100°C for 10 hours and the reaction conditions in the synthesis of the present polyamide acid resin (A) obtained by reaction (amidation) of the present polyester resin (a) with a diamine (b) are 15°C for 24 hours.

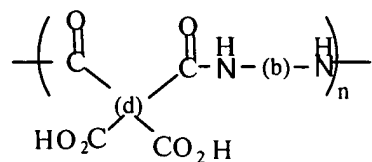
It is clear from the above reaction conditions of both of present invention and Koyanagi et al. that the

esterification needs higher reaction temperature (98°C or 100°C) than amidation (40°C or 15°C). Accordingly, in Koyanagi et al., if polyol compound (c), a diamine compound (d) and a dianhydride compound (e) are reacted simultaneously, firstly, amidation reaction proceeds and then esterification reaction proceeds. Further, according to paragraph [0022] in Koyanagi et al., when the total equivalent of polyol compound (c) and a diamine compound (d) is 1, the equivalence of dianhydride compound (e) is 0.1 to 0.9. Accordingly, in the above (i) (the simultaneous method) the present polyester resin (a) is never synthesized because firstly, amidation reaction proceeds and thereafter dianhydride compound (e) does not present excess to the polyol compound (c). For synthesis of the present polyester resin (a), the excess presence of dianhydride compound (e) to the polyol compound (c) is necessary because the present polyester resin (a) has a terminal hydride group.

Accordingly, the reaction in Koyanagi et al. can be represented by the following reaction scheme:



Accordingly, Koyanagi's oligomer (A) has the structure wherein the polyamide prepolymer (f) having one or more the parenthetic amide units (polyamide unit)



is further linked with diol represented by formula (c) by ring-opening addition polymerization (esterification).

It is clear that the present polyamide acid resin (A) has a structure wherein polyester units are linked with an amide bond, and Koyanagi's oligomer (A) has a structure wherein polyamide units are linked with an ester bond. Accordingly, the present polyamide acid resin (A) has an entirely different structure from Koyanagi's oligomer (A).

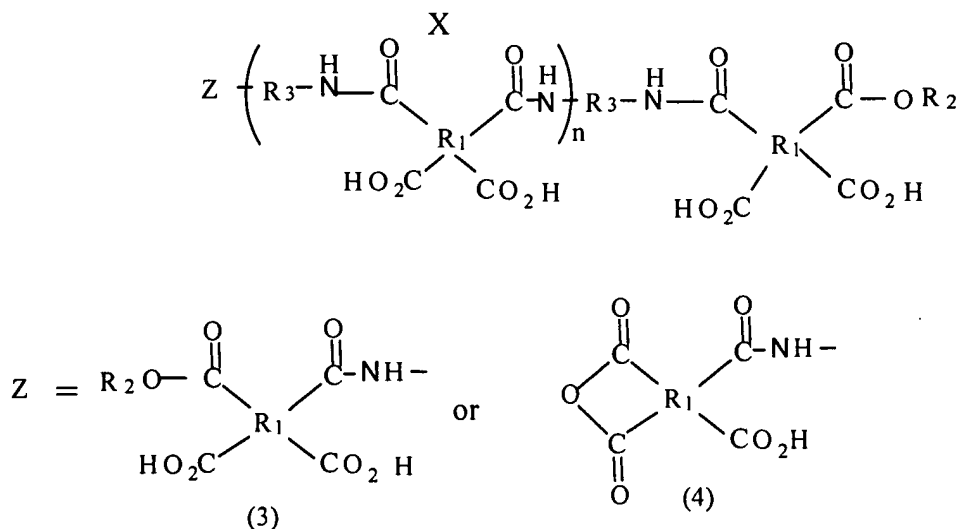
Accordingly, the present claim 2 and claim 9 are not anticipated by Koyanagi et al. and further, are not obvious over Koyanagi et al. because Koyanagi et al. do not disclose or suggest the present polyamide acid resin (A) having a structure linking polyester units with amide bond.

The Examiner also rejects claims 2-10 under 35 U.S.C. §103(a) as being unpatentable over Nomura et al., U.S. Patent No. 5,310,862, in view of Nishikubo et al., U.S. Patent No. 3,923,523. The Examiner states that Nomura et al. disclose a photosensitive polyimide precursor composition containing poly(amic acid) obtained by reacting a diamine (which can be 4,4'-diaminodiphenylmethane) to a tetracarboxylic monoester monoanhydride, which is prepared by adding alcohol ((meth) acrylic acid ester) to a tetracarboxylic dianhydride (which can be pyromellitic acid) to form a polyol. The Examiner admits that Nomura is silent as to a polyester obtained by reacting (meth)acrylic acid with epoxy to form a polyol, but cites Nishikubo et al. as

disclosing a polyester obtained from a polyol having a photopolymerizable unsaturated ester group and a polycarboxylic acid anhydride such as pyromellitic acid dianhydride. The polyol is formed by reacting Bisphenol A and acrylic acid to form a photopolymerizable α,β -unsaturated ester group, and then the polyol is reacted with equal moles of pyromellitic acid dianhydride to form the polyester. The Examiner concludes that it would have been obvious to modify the polyamic acid of Nomura et al. and use the polyol obtained by reacting Bisphenol A with acrylic acid as taught by Nishikubo et al., to improve the curing and crosslinking speed.

The rejection is respectfully traversed.

The poly(amic acid) of Nomura et al. is represented by the following general formula(1):



R1 =a tetravalent organic group,

R2 = a monovalent organic group of 1 to 15 carbon atoms not containing unsaturated bond, or a monovalent organic group of 3 to 15 carbon atoms containing carbon-carbon unsaturation having photoreactivity.

R3 = a divalent organic group having 1 to 22 carbon atoms

The Examiner states that it would have been obvious to one of ordinary skill in the art the time of the invention to have modified the polyamide acid disclosed by Nomura et al. and use the polyol obtained by reacting Bisphenol A with acrylic acid, because the resultant polyamide acid has better curing and crosslinking speed (page 7, first paragraph of the Office Action).

However, it is clear that the poly(amic acid) of Nomura et al. has polyamide units represented by Xn in Nomura's formula (1) and this polyamide unit never changes by use of the polyol obtained by reacting Bisphenol A with acrylic acid shown, and the present polyamide acid resin (A) never has such polyamide unit represented by X.

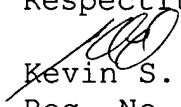
Accordingly, if the polyol of Nishikubo et al. is used instead of the alcohol of R2-OH in Nomura et al. in the invention of Nomura et al., the present polyamide acid resin (A) would never be obtained. Accordingly, the present polyamide acid resin (A) of the instant claims is not

disclosed or suggested by Nomura et al. and Nishikubo et al, alone or in combination.

New claim 18 has been added to further define the invention. It is a combination of claims 5-8.

Reconsideration and allowance are respectfully requested in view of the foregoing.

Respectfully submitted,


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Appendix

A partial translation of JP2001-192431 is attached.

JP2001-192431 Partial English Translation

[0022]

Next, the method for producing an oligomer (A) by reacting the above obtained polyunsaturated polyol compound (c) and a diamine compound (d) with a compound (e) having at least two acid anhydride groups in one molecule includes a method where these are reacted at the same time and a method where (d) and (e) are reacted to synthesize a polyamide prepolymer and then (c) is reacted. As the method of reacting at the same time, when the total equivalent of the hydroxy group in the above polyunsaturated polyol compound (c) and the amino group in the above diamine compound (d) is 1 equivalent, it is preferred to react 0.1 to 0.9 equivalent (as acid anhydride equivalent) of the compound (e) having two acid anhydride groups in one molecule. The reaction temperature is preferably 0 to 150°C, the reaction time is preferably 1 to 10 hours, and 0.1 to 10% of a catalyst such as triethylamine may be added.

[0023]

As the method where a polyamide prepolymer is synthesized and then a polyunsaturated polyol compound (c) is reacted, a diamine compound (d) and a polybasic acid anhydride (e) having at least two acid anhydride groups in a molecule are first reacted to prepare an acid anhydride-terminated polyamide prepolymer (f) and then a polyunsaturated polyol compound (c) is reacted.

[0024]

As for the acid anhydride-terminated polyamide prepolymer (f), it is preferred that 1.05 to 2.05 equivalent (as acid anhydride equivalent) of the polybasic acid anhydride (e) having at least two acid anhydride groups in a molecule is reacted relative to 1 equivalent of the amino group in the diamine compound (d). In this amidation reaction, the reaction temperature is usually 0 to 80°C and the reaction time is preferably 1 to 10 hours.

[0025]

Then, the acid anhydride-terminated polyamide prepolymer (f) is reacted with a polyunsaturated polyol compound (c) to obtain an oligomer (A). Relative to 1 equivalent of the hydroxy group in the polyunsaturated polyol compound (c), preferably 0.05 to 0.95 equivalent of and particularly preferably 0.1 to 0.8 equivalent of the acid anhydride group in the acid anhydride-terminated polyamide prepolymer is reacted. The reaction temperature is usually from an ordinary temperature to 100°C and preferably 50 to 90°C. In order to prevent gelation by radical polymerization during this reaction, it is preferred to add usually 50 to 2000 ppm of a polymerization inhibitor such as hydroquinone, hydroquinone monomethyl ether, p-methoxy phenol and p-benzoquinone. The reaction of these hydroxy and acid anhydride groups proceeds without any catalyst, but a basic compound such as, for example, triethylamine and triphenylphosphine may be added as a catalyst.

[0054]

Synthesis Example 3 (synthesis of acid anhydride-terminated polyamide prepolymer (f))

Into a round-bottom flask equipped with a stirring device and a cooling tube, 200.2 g of 3,4'-diaminophenyl ether, 436 g of pyromellitic dianhydride (trade name: PMDA, manufactured by Mitsubishi Gas Chemical Company, INC.) and 636.2 g of gamma-butyrolactone were added, and the mixture was reacted at 40°C for about 5 hours to obtain an acid anhydride-terminated polyamide prepolymer (f-1) having a solid acid value of 519.6 mg KOH/g and a solid content of 50%.

[0055]

Synthesis Example 4 (synthesis 1 of oligomer (A))

Into a round-bottom flask equipped with a stirring device and a cooling tube, 456.5 g of (c-1) obtained in Synthesis Example 1, 50 g of 3,4'-diaminophenyl ether, 109 g of pyromellitic dianhydride (product name: PMDA, manufactured by Mitsubishi Gas Chemical Company, INC.) and 410 g of gamma-butyrolactone were added, and then the mixture was reacted at 40°C for 5 hours and, with the temperature raised to 98°C, further reacted for 24 hours to obtain an oligomer (A-1) having a solid acid value of 89.5 mg KOH/g and a solid content of 60%.

[0056]

Synthesis Example 5 (synthesis 2 of oligomer (A))

Into a round-bottom flask equipped with a stirring device and a cooling tube, 470.6 g of (c-2) obtained in Synthesis Example 2, 50 g of 3,4'-diaminophenyl ether, 109 g of pyromellitic dianhydride (product name: PMDA, manufactured by Mitsubishi Gas Chemical Company, INC.) and 420.3 g of gamma-butyrolactone were added, and the mixture was reacted at 40°C for 5 hours and, with the temperature raised to 98°C, further reacted for 24 hours to obtain an oligomer (A-2) having a solid acid value of 87.5 mg KOH/g and a solid content of 60%.

[0057]

Synthesis Example 5 (synthesis 3 of oligomer (A))

Into a round-bottom flask equipped with a stirring device and a cooling tube, 470.6 g of (c-2) obtained in Synthesis Example 2, 763.4 g of (f-1) obtained in Synthesis Example 3 and 186.5 g of gamma-butyrolactone were added, and after the temperature was raised to 60°C and they were dissolving, the mixture was reacted at 98°C for 24 hours to obtain an oligomer (A-3) having a solid acid value of 116.4 mg KOH/g and a solid content of 60%.